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GB 2143966 A GB 1568470 A

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INT CL[6] G05D 25/00 25/02, H05B 37/02
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# (54) Public lighting control unit

(57) A public lighting control unit 1 has a controller 3 which controls a lamp load via an output switch module 5 and a photoelectric control unit socket 2. The output signal is generated according to a daylight level signal received from a light sensing module 10, a real time signal received from an LW receiver 29 and an auxiliary signal received from a remote source via an auxiliary signal receiver 19. The real time signal in conjunction with the other signals allows comprehensive control and because it is received from a remote source, there is no need for resetting circuits after a power failure. The controller 3 can operate in a test mode in response to auxiliary signals, eg for testing operation of the lighting at intermediate light levels. The control may incorporate a transmitter for transmitting monitoring information to a remote monitoring device.

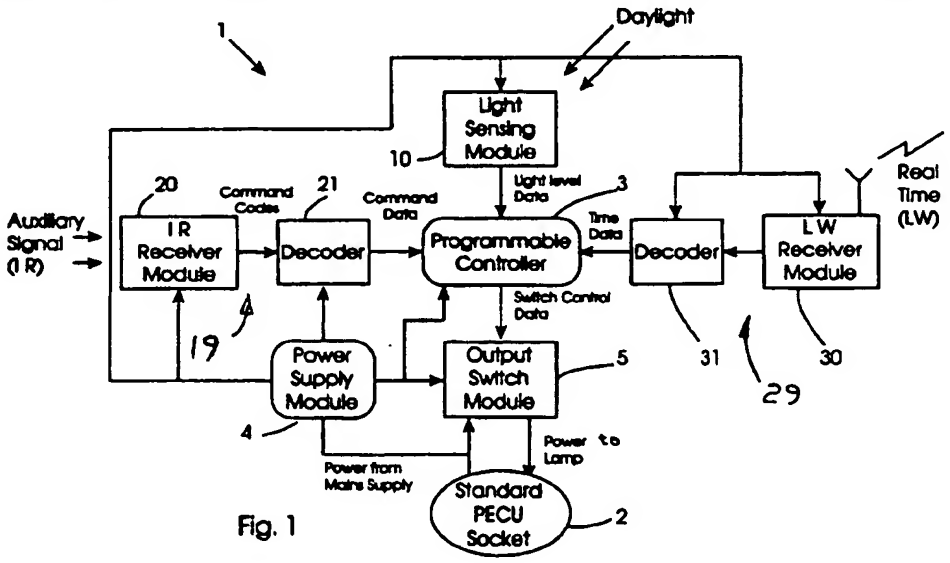


Fig. 1

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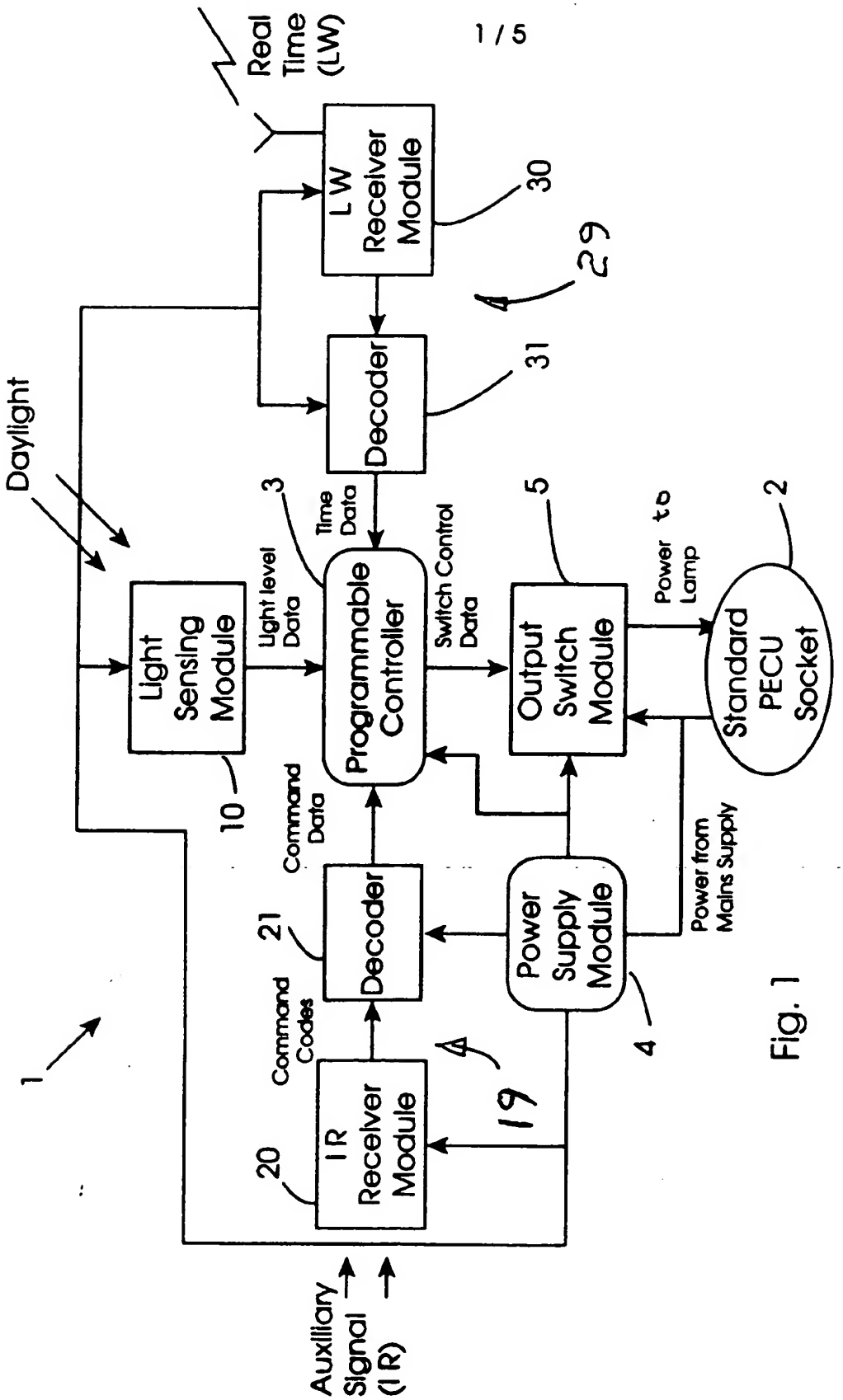
Real Time (LW)
LW Receiver Module
30
29
Decoder
31
Daylight
3
Time Data
Light Sensing Module
Light level Data
Programmable Controller
Switch Control Data
5
Output Switch Module
Power to Lamp
2
Standard PECU Socket
10
Command Data
Decoder
21
Power Supply Module
Power from Mains Supply
4
Command Codes
IR Receiver Module
20
19
1
Auxiliary Signal (IR)

Fig. 1

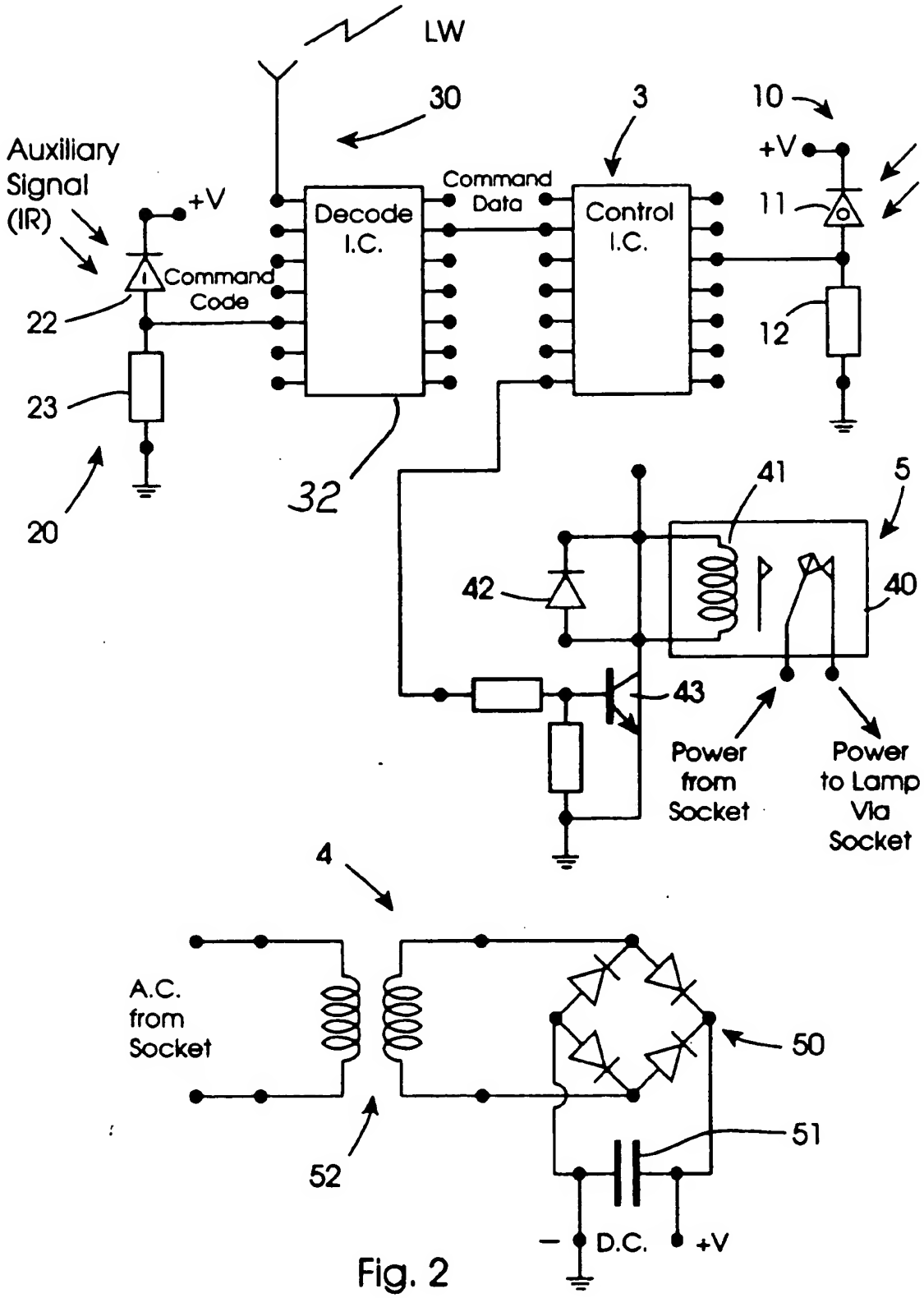
LW
30
3
10
+V
Auxiliary
Signal
(IR)
+V
Command
Code
Decode
I.C.
Command
Data
Control
I.C.
11
22
12
23
32
20
41
5
42
40
43
Power
from
Socket
Power
to Lamp
Via
Socket
4
A.C.
from
Socket
50
51
52
D.C.
+V

Fig. 2

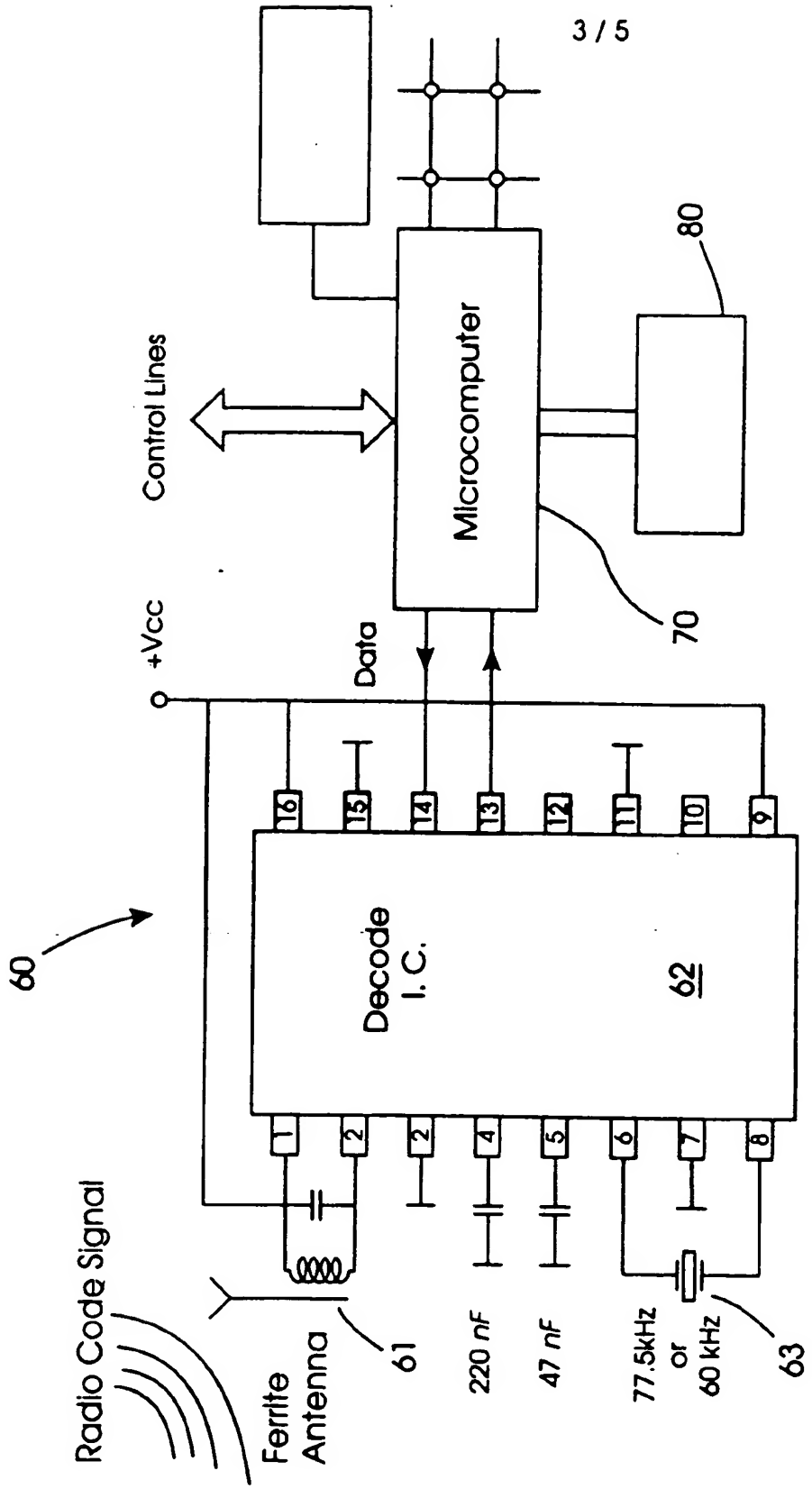
80
Microcomputer
Control Lines
70
+Vcc
Data
60
Decode
I. C.
62
16
15
14
13
12
11
10
9
1
2
2
4
5
6
7
8
Radio Code Signal
Ferrite
Antenna
61
220 nF
47 nF
77.5kHz
or
60 kHz
63

Fig. 3

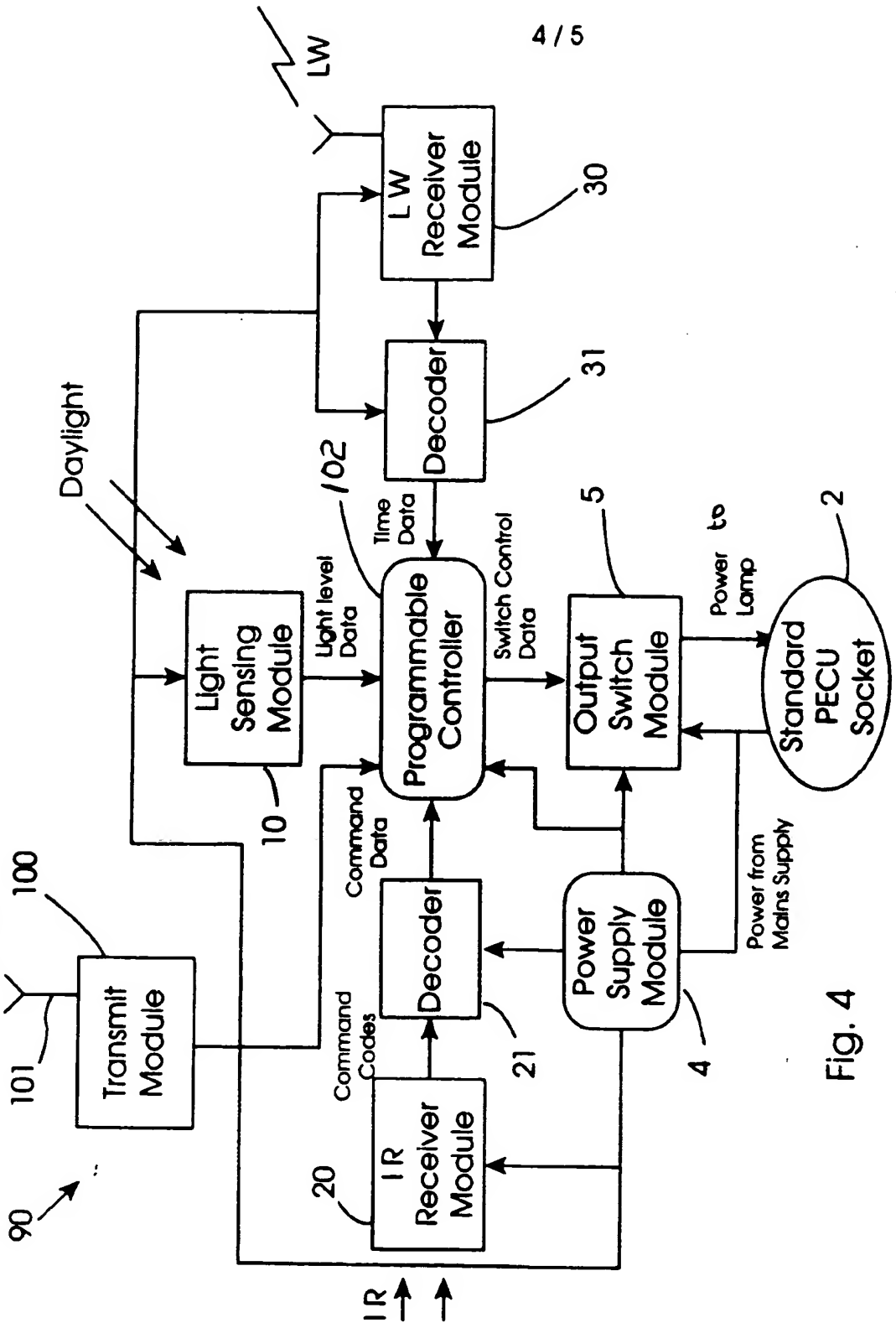
LW
LW Receiver Module
30
Decoder
31
Daylight
102
Time Data
Light Sensing Module
Light level Data
Programmable Controller
Switch Control Data
Output Switch Module
5
Power to Lamp
Standard PECU Socket
2
10
Command Data
100
Transmit Module
101
Decoder
Power Supply Module
Power from Mains Supply
Command Codes
21
4
90
IR Receiver Module
20
IR

Fig. 4

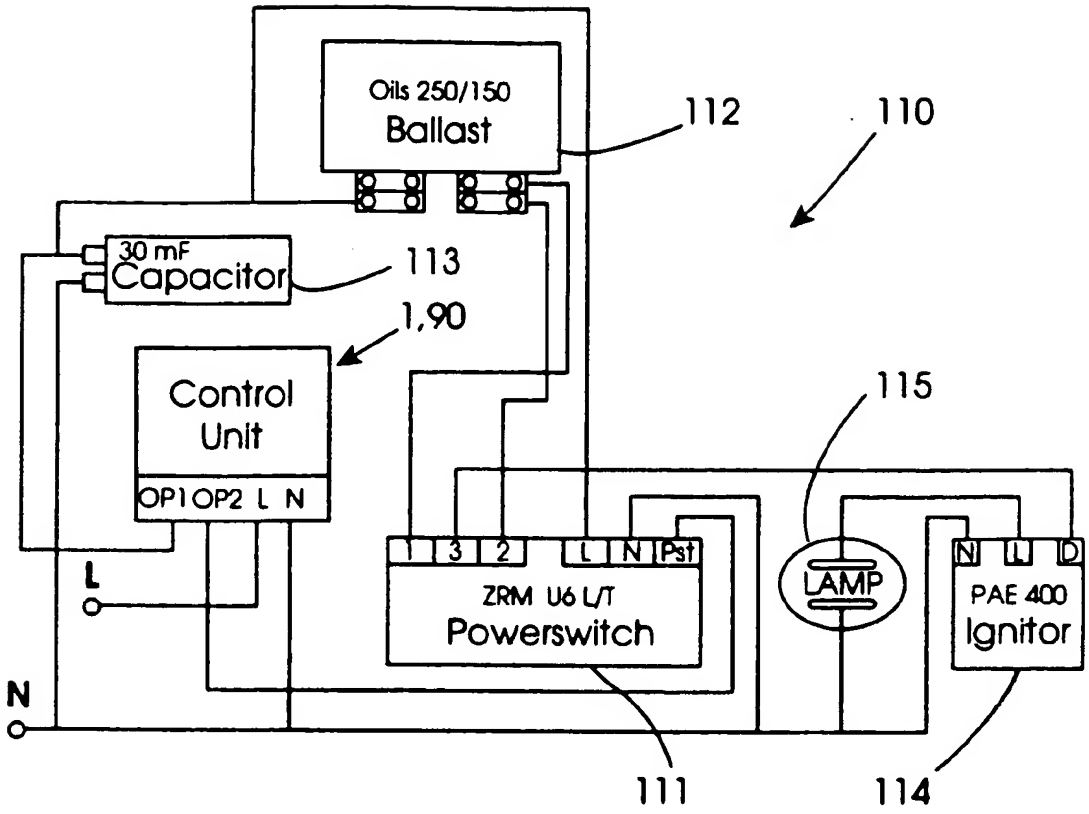
Oils 250/150
Ballast
112
110
30 mF
Capacitor
113
1,90
Control
Unit
OP1 OP2 L N
115
1 3 2 L N Pst
ZRM U6 L/T
Powerswitch
LAMP
N L D
PAE 400
Ignitor
L
N
111
114

Fig. 5

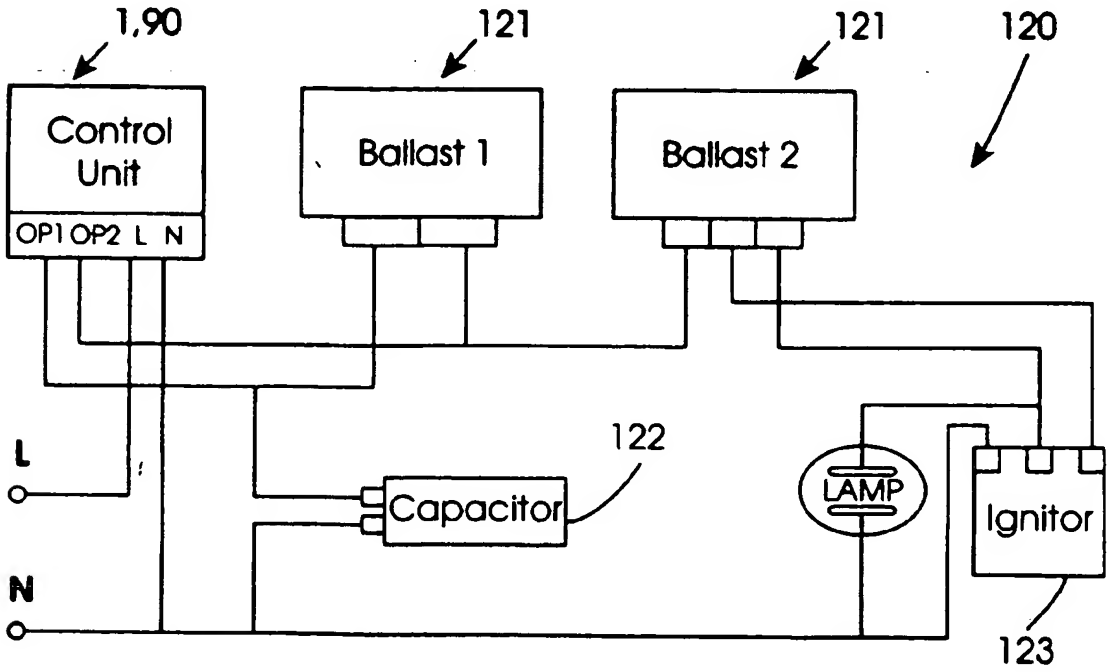
1,90
121
121
120
Control
Unit
OP1 OP2 L N
Ballast 1
Ballast 2
L
122
Capacitor
LAMP
Ignitor
N
123

Fig. 6

"A Public Lighting Control Unit"

Introduction

The invention relates to a public lighting control unit for control of lamps for lighting public areas such as streets. In any one built-up area, there are generally many thousands of such lamps, the responsibility for which usually lies with the local authority. There are two main costs associated with maintaining public lighting, namely maintenance of the lamps and provision of electrical energy for the lamps.

Regarding maintenance, this is often very costly as the control units are very often at inaccessible locations such as the top of the lamp standard. Accordingly, a very high labour cost arises for accessing the control units and making any necessary adjustments or repairs. The second item, namely provision of electrical energy for the lamps has remained very expensive because of the limited level of control of lamps which has heretofore been provided. For example, heretofore street lamps have been controlled only in response to daylight levels sensed by a photocell in the control unit. Even when the photocell is operating correctly, an unnecessarily large level of power consumption is required.

Although there have been some improvements to provide an additional level of control, control of public lighting has still remained very costly. For example, in British Patent Specification No. GB 1,568,470 (Davey), a control unit is disclosed in which a radio receiver is tuned to detect transmitted radio waves. Daylight and received radio signals are inputted to a comparator so that the lamp is energised only when the daylight level signal indicates that the ambient light level is below a pre-

determined value and the radio receiver is receiving a transmitted radio signal. While this arrangement does provide an input in addition to the daylight level input, comprehensive control has not been achieved.

## Statements of Invention

According to the invention, there is provided a public lighting unit comprising :

load terminals for connection to a lamp;

a lamp switch for switching a lamp load;

means for determining daylight level and for delivering a daylight level signal to the controller;

means for receiving a remotely transmitted auxiliary signal and for delivering an auxiliary signal to the controller;

a radiation receiver for receiving a broadcast radiation signal indicating real time and for delivering a real time signal to the controller; and

means in the controller for processing received daylight level, real time and auxiliary signals and controlling the lamp switch in real time according to processing of the signals.

Thus, the invention provides in an extremely simple and inexpensive manner for very comprehensive control of a lamp. The use of broadcast radiation real time signals (such as that emitted by the atomic clock system located at Rugby, England) allows for a third level of control which is extremely important at providing for such things

as energy conservation. This level of control has been achieved without any significant increase in complexity of the control unit or a requirement for additional maintenance. Even if there is a power failure, the control unit can immediately resume operation with all three signals when power is restored. There is no need for a back-up power supply to avoid the need to re-set clock circuits after a power failure.

In one embodiment, the controller further comprises a clock circuit and means for synchronising the clock circuit with the received real time signals. This is a very simple arrangement which allows the controller to additionally maintain an internal clock for use in the event if there is an interruption in the broadcast real time signals.

Preferably, the controller comprises means for matching clock cycles of the clock with the received real time signals. Once the frequency of the clock circuit is matched with that of the received real time signal, the two signals may be maintained in synchronism for lengthy periods, re-synchronisation only been required to prevent a significant error arising due to inaccuracy of the clock circuit as compared to the received real time signals.

Preferably, the radiation receiver is tuned to LW broadcasts.

In another embodiment, the controller comprises means for recognising test codes embedded in received auxiliary signals and for controlling the lamp switch in response in an override test mode. By recognising test codes, the controller can use the auxiliary signal to override the other signals and for what is usually a short time duration operate the lamp switch in a test mode as

desired. This prevents the need for access to the control unit for testing and saves a considerable amount of time.

In this latter embodiment, the controller preferably comprises means for controlling the lamp switch to cause lamp light output at one or more intermediate levels between on and off, and means for testing these levels in the test mode. This allows control of not only the on and off lamp levels but also the intermediate or "dimming" levels therebetween for very comprehensive testing. This is very important, particularly as lamp switches which provide for dimming are of necessity more complex than conventional lamp switches and are therefore more likely to develop faults.

What the invention therefore achieves is the major energy-conserving advantage of use of dimming lamp switches because of use of a real time signal, without the disadvantage of considerable additional maintenance time input being required.

In a further embodiment, the controller comprises means for recognising energy-saving instructions embedded in the auxiliary signal and for controlling the lamp switch in response in real time in an energy-saving manner. Because the auxiliary signal is received from a remote source, this feature of the invention allows an authority responsible for public lighting to implement energy-conserving measures in a very simple manner. A single signal which is broadcast by radiation or alternatively transmitted on the mains can immediately cause energy-conserving operation. This may take the form of switching off the lamps at particular times, or of dimming them at particular times. The important signals in this instance are the combination of the auxiliary and real time signals, the daylight signals being over-ridden to some

extent. Again, the combination of the three signals makes this comprehensive level of control possible.

In one embodiment, the controller comprises means for causing lamp light output at on, off and intermediate levels in real time. This allows energy conservation without switching off the lamp totally.

Preferably, the control unit further comprises a transmitter, and the controller comprises means for capturing lamp information and directing transmission of the information to a remote monitoring device. This feature allows capturing of lamp information in a very simple manner at a central monitoring site. Thus, any faults which arise in a control unit or in a lamp to which it is connected are easily identified.

In one embodiment, the lamp information includes energy consumption information. This allows logging of energy consumption information and generation of management reports and identification of electrical faults.

## Detailed Description of the Invention.

The invention will be more clearly understood from the following description of some embodiments thereof, given by way of example only with reference to the accompanying drawings, in which :-

Fig. 1 is a diagram illustrating construction of a control unit of the invention;

Fig. 2 is a more detailed diagram showing construction of the control unit;

Fig. 3 is a diagram illustrating an alternative construction of parts of the unit;

Fig. 4 is a diagram illustrating construction of an alternative control unit of the invention; and

Figs. 5 and 6 are diagrams illustrating connection of control units of the invention to lamp switches.

Referring to Figs. 1 and 2, there is shown a control unit 1 of the invention. The unit 1 comprises a standard PECU (photoelectric control unit) socket 2 for connection with a lamp load. The unit 1 is for mounting on a public lighting lamp standard for controlling a particular lamp. Power is received from a mains supply via the socket 2.

The unit 1 comprises a programmable controller 3, which is shown in Fig. 2 comprises a control integrated circuit. A power supply module 4 receives AC mains power from the socket 2 and provides DC power for the unit 1. As shown in Fig. 2, the module 4 comprises a step-down transformer 52, a full-wave rectifier 51, and a smoothing capacitor 51 connecting across the rectifier 50. The controller 3 controls an output switch module 5 which comprises switching contacts 40 controlled by a solenoid 41 and, a diode 42 and a transistor 43. The module 5 is of conventional construction.

The controller 3 operates using three main inputs, namely daylight level, real time, and auxiliary signals. The daylight level signal is provided by a light sensing module 10, which as shown in Fig. 2 comprises a photocell 11 connected to earth via a resistor 12. The auxiliary signal is received by an infra-red receiver module 20 having a photocell 22 and a resistor 23 connecting it to

earth. The auxiliary signal receiver also comprises a decoder 21.

The real time signal is delivered to the controller 3 by a receiver 29 comprising a long wave (LW), antenna 30 connected to a decoder 31. The decoder 31 is a functional block within the decode IC 32 shown in Fig. 2.

The controller 3 is programmed to process the three signals to provide a real time control output for the switch module 5. The three signals may be combined to provide the output, or alternatively the daylight level or real time signals may for the timebeing be ignored if such a code or instruction is embedded in the auxiliary signal. This allows very versatile and comprehensive control of public lighting.

Because the real time signal is received via a broadcast radiation signal, the unit may immediately re-start operating in real time after a power failure. This considerably reduces maintenance and re-configuration time input required of the authorities responsible for the public lighting. Further, the real time signals which are broadcast are generally very accurate, one example being the atomic signal generated by the long wave transmitter located at Rugby, England. The invention also avoids the need for providing a back-up power supply, which adds expense and complexity with resulting maintenance costs. It must be borne in mind that control units of the invention will also be located at remote and inaccessible locations and it is thus very important to minimise the physical access which is required.

Because the controller 3 "knows" both daylight level and real time, it can provide a wide range of outputs for comprehensive lamp control. For example, it may switch on

at any desired time set according to sunset, such as one hour beforehand. Equally, it can switch off at a pre-set time according to sunrise, such as one hour afterwards. In between these times, it can switch off the light at certain periods such as between 3:00 am and 5:00 am. Alternatively, it could cause the lamp to be dimmed for energy conservation during such a period.

The authority responsible for the street lighting may provide the auxiliary signal in any suitable manner. For example, it may be broadcast as a radio signal, in which case a comprehensive set of instructions is transmitted to all control units within a certain geographical area. Such a broadcast may be used, for example, for energy consumption at particular times of the year which are not pre-programmed in the controller 3. Again, this provides a large degree of versatility.

Referring to Fig. 3, an alternative construction of the control unit is shown in which the controller is a micro-computer 70 which receives real time signals from a receiver 60 having a decode integrated circuit 62, a ferrite antenna 61, and a clock circuit 63. While not as accurate as the broadcast real time signal, the clock circuit 63 provides a stand-by time signal, once it has been synchronised by the decode IC 62 with the received real-time signal. If the decode IC 62 matches clock cycles of the clock 63 with those of the received time signals, re-synchronisation need not be carried out frequently. The decode IC may be programmed, for example to switch off its "listening" function for elimination of energy to the antenna for pre-programmed periods of time, reference being made to the clock 63 during these times.

Another important aspect of the invention is that the decode IC or alternatively the programmable controllers 3

illustrated in Fig. 1 may be programmed to recognise test codes embedded within the received auxiliary signals. In response to such test codes, the controller can to control the switch module 5 in an override test mode for a period of time. Thus, both the daylight and the real time signals are generally overridden to switch on the lamp either fully or in a "dimming" mode for comprehensive testing. Again, because the auxiliary signal is received from a remote source such as a hand-held transmitter or a central transmitting station, there are considerable savings in labour of maintenance personnel.

Referring now to Fig. 4, a control unit 90 is illustrated in which parts similar to those with reference to Fig. 1 are identified by the same reference numerals. In this embodiment, the control unit 90 comprises a transmit module 100 having an antenna 101 for transmitting radio signals. The transmit module 100 is connected to a controller 102. The controller 102 is programmed to capture items of information relating to lamp operation. This may be achieved because of its access to real-time signals. Thus, for example, it may provide an indication of lamp energy consumption by performing simple calculations using real time and switch operation inputs. Additionally, it may capture fault information relating to either faults in the control unit or in the lamp load circuit. This information may be delivered to the transmit module 100 which transmits the signal to a central monitoring station. This also provides for comprehensive capture of management information and/or maintenance information to reduce maintenance time required.

As mentioned above, the control unit of the invention may be connected to a lamp switch circuit which reduced the load energy consumption without switching the lamp off.

For example, as shown in Fig. 5, the control unit is connected so that one output switch within a switch module provides power to a load circuit 110 which comprises a power switch 111, a balance 112, a capacitor 113, an igniter 114 and lamp terminals 115. A second output, namely OP2 of the switch module controls the power switch 111 which configures the balance 112. This provides for comprehensive lamp control at a number of intermediate levels between on and off. Referring to Fig. 6, the control unit is connected in a load circuit 120 having a pair of ballasts 121, a capacitor 122, an igniter 123 and lamp terminals 124. In this embodiment, the output ports are used to switch on one or both of the ballasts 121.

The invention is not limited to the embodiments hereinbefore described. For example, it is envisaged that instead of sensing daylight level, the controller may incorporate a programmed astronomical timer. Such a timer may include a certain amount of code embedded in non-volatile memory to allow self-initialisation with reference to the real-time signal after a mains failure. Further, it is envisaged that the auxiliary signals may be received via the mains and equally the captured information may be transmitted by the mains instead of by radiation.

CLAIMS

1. A public lighting control unit comprising :

load terminals for connection to a lamp;

a lamp switch for switching a lamp load;

means for determining daylight level and for delivering a daylight level signal to the controller;

means for receiving a remotely transmitted auxiliary signal and for delivering an auxiliary signal to the controller;

a radiation receiver for receiving a broadcast radiation signal indicating real time and for delivering a real time signal to the controller; and

means in the controller for processing received daylight level, real time and auxiliary signals and controlling the lamp switch in real time according to processing of the signals.

2. A public lighting control unit as claimed in claim 1 wherein the controller further comprises a clock circuit and means for synchronising the clock circuit with the received real time signals.

3. A public lighting control unit as claimed in claim 2 wherein the controller comprises means for matching clock cycles of the clock with the received real time signals.

4. A public lighting control unit as claimed in any of claims 1 to 3 wherein the radiation receiver is tuned to LW broadcasts.

5. A public lighting control unit as claimed in any preceding claim wherein the controller comprises means for recognising test codes embedded in received auxiliary signals and for controlling the lamp switch in response in an override test mode.

6. A public lighting control unit as claimed in any preceding claim wherein the controller comprises means for controlling the lamp switch to cause lamp light output at one or more intermediate levels between on and off, and means for testing these levels in the test mode.

7. A public lighting control unit as claimed in any preceding claim wherein the controller comprises means for recognising energy-saving instructions embedded in the auxiliary signal and for controlling the lamp switch in response in real time in an energy-saving manner.

8. A public lighting control unit as claimed in claim 7 wherein the controller comprises means for causing lamp light output at on, off and intermediate levels in real time.

9. A public lighting control unit as claimed in any preceding claim wherein the control unit further comprises a transmitter, and the controller comprises means for capturing lamp information and directing transmission of the information to a remote monitoring device.

10. A public lighting control unit as claimed in claim 9 wherein the lamp information includes energy consumption information.

11. A control unit substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

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The Patent Office

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|---|---|---|---|
| **Application No:** | GB 9615981.9 | **Examiner:** | David Mobbs |
| **Claims searched:** | 1-11 | **Date of search:** | 8 October 1996 |

## Patents Act 1977
## Search Report under Section 17

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): G3N NGA9, NGCA, NGCA5, NGCA5A, NGL.

Int Cl (Ed.6): G05D 25/00, 25/02; H05B 37/02.

Other: ONLINE: WPI.

**Documents considered to be relevant:**

| Category | Identity of document and relevant passage | Relevant to claims |
|---|---|---|
| A | GB 2,143,966 A (DAY) | |
| A | GB 1,568,470 (DAVEY) referred to on page 1 of the application. | |

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|---|---|---|---|
| X | Document indicating lack of novelty or inventive step | A | Document indicating technological background and/or state of the art. |
| Y | Document indicating lack of inventive step if combined with one or more other documents of same category. | P | Document published on or after the declared priority date but before the filing date of this invention. |
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